June 17, 2005

The Honorable Bennie G. Thompson
Ranking Member
Committee on Homeland Security
House of Representatives
Washington, DC 20510

The Honorable Edward J. Markey
House of Representatives
Washington, DC 20510

Dear Mr. Thompson and Mr. Markey,

Thank you for your letter of March 9, requesting technical information on the ability of portal monitors to detect the smuggling of high-enriched uranium (HEU). We at CSTSP have consulted with Professor Frank von Hippel of Princeton University and Professor Steve Fetter of the University of Maryland, both of whom are physicists with extensive experience in issues related to national security. Together with Professors von Hippel and Fetter, we have reviewed the report on this topic by Thomas B. Cochran, Matthew McKinzie, and Art Seavey entitled, "An Assessment of U.S. Customs and Border Protection's Ability to Detected HEU in Cargo Containers Using Passive Radiation Portal Monitors" (Natural Resources Defense Council, 14 March 2005).

Before addressing specific questions, it is important to note that to provide fully authoritative answers would require detailed technical (and probably classified) information about the portal monitor systems in use at ports of entry, including operational procedures and methods of data analysis, to which we do not have access. Our assessment is therefore based on general experience with the detection of radiation, together with information in the public domain, such as that contained in the Cochran *et al*. report.

Regarding specific questions:

1) In the panel's opinion, would a mass of HEU similar in shape, packaging and location within a similar shipping container be distinguishable from naturally occurring background radiation (NORM) using radiation portal monitors, physical configurations, algorithms, and alarm settings that are currently deployed by DHS at ports of entry?

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We have reviewed the analysis in the Cochran *et al*. report, which concludes that a several-kilogram cylinder of uranium metal, shielded by a few millimeters of lead and steel and placed in a shipping container, is likely to escape detection by portal monitors using current detectors, algorithms, and operational procedures. Although we have not reproduced these calculations in detail, this conclusion appears to be based on solid analysis.

We also note that the minimally-shielded solid uranium cylinder analyzed in the Cochran *et al.* report represents nearly an optimum case for detection. Relatively simple means exist for avoiding detection that could allow kilogram quantities of HEU to evade detection by even significantly more sensitive and sophisticated passive detection systems than those presently in use.

2) Please list and summarize any limitations of the radiation portal monitors, physical configurations, algorithms, and alarm settings that are currently deployed by DHS at ports of entry in their ability to distinguish between a sample of HEU identical in size and packaging to the DU sample smuggled into the U.S. by ABC News from naturally occurring background radiation and NORM.

The portal detectors in use are limited in several ways. The most important limitation is their very poor energy resolution, which severely limits their ability to identify radioactive sources and thereby distinguish between potentially hazardous sources and NORM. Detector capabilities are also limited by the large width of the portal and the correspondingly large distance between the detectors and potential radioactive sources passing through the portal; the short counting time available for collecting data; and the lack of collimation to reduce the background signal.

3) In the panel's opinion, can additional R&D to develop cost effective improvements to the technology address any of the limitations? If so, please list and summarize the areas of research focus that are required, including the degree to which the limitation would be solved by a particular technology improvement and an estimate for how long it will take to develop and deploy such an improvement and the relative cost of the new technology and procedures.

Additional R&D may improve detection capabilities by making available less-expensive, higher-energy-resolution detectors and automatic data collection and analysis systems that can reliably identify radioisotopes and distinguish between potentially hazardous sources and NORM in order to minimize false alarms. One example is the system recently developed at the Princeton Plasma Physics Laboratory, which is described at http://www.pppl.gov/news/pages/minds_license.html.

We note that any system that depends on detecting HEU at a U.S. port of entry is a source of great danger if that HEU has been fashioned into a nuclear device. Such a device could easily be set to detonate automatically upon arrival at a U.S.. For that reason, we would like to call your attention to a proposal by Dr. Samit Bhattacharyya for an "offshore detection integrated system" using inexpensive detectors affixed to cargo containers prior to departure from the port of origin. Such a system may potentially be far more sensitive than a portal detector, because of the lengthy time available for data collection during transoceanic transit and the large total number of detectors on each ship. More importantly, it could detect potentially hazardous cargo at sea, far from populated cities. We have attached a brief description of this proposal.

Finally, we wish to emphasize that HEU—particularly HEU that is uncontaminated by reprocessed uranium—is inherently very difficult to detect using passive detection methods. Uncontaminated HEU emits very few neutrons, and most of the photon emissions are of relatively low energy and are easily shielded. More reliable methods for detecting and characterizing HEU use an "active" approach, such as radiography or the stimulation of fission with neutron sources (*i.e.,* the Nuclear Material Identification System developed by Oak Ridge National Laboratory or a similar system specifically being developed for use with cargo by Lawrence Livermore National Laboratory), which should greatly increase the likelihood of detection. Because of concerns about the cost and health and safety of active sources, R&D might focus on active methods that use natural sources of radiation, such as cosmic-ray neutrons or muons or the photons produced by terrestrial radionuclides.

Because of the challenges of reliably detecting HEU, the very highest priority should be assigned to safeguarding all stocks of HEU, at home as well as abroad. Due to its very low rate of neutron emission, HEU can be fashioned into a simple gun-type nuclear weapon—a technology that is well within the reach of virtually all countries and sophisticated subnational groups. Thus, stocks of HEU should be accorded the same level of security as nuclear weapons. Efforts also should be made to reduce and eliminate stocks of HEU whenever possible. The conversion of HEU-fueled research reactors and critical assemblies, which are still widespread, is also very important.

4) In the panel's opinion, can engineering solutions such as additional shielding or placing the detectors closer to the samples being screened address any of these limitations? If so, please summarize each such solution, including the degree to which the limitation would be solved by a particular engineering solution.

Existing portal detection systems could be made somewhat more effective by making the portal as narrow as possible and increasing the counting time (e.g., by reducing vehicle speed) to the maximum practical extent. For example, halving the width of the portal would increase the sensitivity of the detection system by a factor of four; quadrupling the counting time would increase sensitivity by a factor of two. Additional shielding around the detectors would decrease background radiation and thereby increase the effectiveness of the scanners. In practice, there may be limitations to achieving these changes in scanning.

Collimation of the detectors and a corresponding modification of the analysis algorithms may also improve the sensitivity of the detectors. We cannot estimate the possible improvement factor, however, without more detailed knowledge of the detection system and algorithms now in use.

We hope that this information, although limited in scope, can be useful. For a deeper look at this complex issue, the committee may want to also consider requesting a detailed technical analysis from an organization such as the National Academy of Sciences, which could include examination of classified information, but would likely take at least one year from when funding is made available.

Sincerely,

Norman Neureiter, Ph.D.
Director